Applicant : Shackleford, J. Barry
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REMARKS

In the Office Action mailed February 2, 2004, the Examiner objected to the language in the specification at page 8, lines 33-4 as the text discussion did not appear to track the referenced FIG. 4. Accordingly, the Applicant has amended this portion of the specification to track the corresponding elements and reference numbers in FIG. 4.

In addition, the Examiner rejected claims 10-18 as directed to non-statutory subject matter citing the "practical application test" requiring that a "useful, concrete and tangible result" be accomplished. Additionally, the Examiner further asserts that these claims represents "abstract methodology and therefore are intangible". Applicant respectively submits that the Examiner's assertions are conclusory and lack analysis thus a prima facie case has not been established. To further the prosecution of the case, the Applicant will provide the analysis lacking in the Examiner's assertion to show that these claims are well within statutory subject matter and the rejection is unsupportable.

First, Applicant would like to point out that claims 10-18 are directed towards a method of manipulating a particular circuit embedded in computer thus is notoriously patentable subject matter under 35 USC 101. For example, amended claim 10 supports this analysis and recites "A method for determining the fitness of a potential solution for a combinatorial genetic algorithm problem" and that this method includes at least the operations of "inputting a plurality of potential solution values into a solution register" and "adding, by an adder connected to each of the respective data tables". The language and context of this claim clearly indicate that the Applicant is claiming a permittable method claim as it relates to operating computing machinery and circuitry and as both registers and adders are recognized as being very real and tangible parts

of a digital electronic circuitry. As explained below, "useful, concrete and tangible result" are clearly accomplished.

In State Street Bank & Trust Co., v. Signature Financial Group, Inc., 149 F.3d 1368, 47 U.S.P.Q.2d (BNA) 1596 (Fed. Cir. 1998), the Federal Circuit articulated the following test for patentability under this section developed from In re Alappat, 33 F.3d 1526; 31 U.S.P.Q.2d (BNA) 1545 (Fed. Cir. 1994), and Arrhythmia Research Technology, Inc., v. Corazonix Corp., 958 F.2d 1053; 22 U.S.P.Q.2d (BNA) 1033 (Fed. Cir. 1992). A claim defines subject matter eligible for patent protection if the claim contains a practical application or, equivalently, if the invention defined by the claim produces "a useful, concrete and tangible result."

1. A result is <u>useful</u> if it lies within the technological arts.

Although the court in *State Street* did not further define the term "useful," courts have previously interpreted "useful" as meaning "in the technological arts. See *Evans v. Eaton*, 16 U.S. 454; 4 L. Ed. 433; 3 Wheat. 454 (1818) (explaining that "a patent may be for a new and useful art; but it must be practical"); *In re Toma*, 575 F.2d 872,___; 197 U.S.P.Q. (BNA) 852, __ (C.C.P.A. 1978) (holding that a "method for enabling a computer to translate natural languages is in the technological arts, *i.e.*, it is a method of operating a machine"); *Ex parte Veldhuis*, 1992 Pat. App. LEXIS 39 (Bd Pat. App.Int. 1992) (noting "the distinction between mathematical algorithms which are the basic tools of scientific and technological work and the technological

application of scientific principles and mathematical algorithms which further the constitutional purpose of promoting 'the progress of science and the useful arts.'").

In the instant case, computations performed by the method recited in claim 10 are directed toward solving a combinatorial class of problems using circuitry designed in accordance with the well known principles of genetic algorithm analysis. In particular, it is the fitness function recited in claim 10 that provides the result used in the combinatorial class of problems encountered by computer systems as recited in claim 10 scheduling planes, trains, shipping containers, computing resources, and other resources in an optimal manner. The traveling salesman problem or TSP is merely a shorthand way of referencing this class of problems by those skilled in the art; the reference to NP complete combinatorial problems is a more technological description of this problems. In either case, the problem clearly occurs in the technological arts and requires carefully designed systems and methods of operating as recited in claim 10.

2. A result is <u>concrete or tangible, and thus not abstract</u>, if it lies within the physical realm.

The terms "tangible" and "concrete" come from the *Alappat* case. In that case, the Federal Circuit explained that "abstract ideas" were "disembodied," or

divorced from physical manifestations. Patentable subject matter, on the other hand, was tangible and concrete.

> Given the foregoing, the proper inquiry in dealing with the so called mathematical subject matter exception to § 101 alleged herein is to see whether the claimed subject matter as a whole is a disembodied mathematical concept, whether categorized as a mathematical formula, mathematical equation, mathematical algorithm, or the like, which in essence represents nothing more than a "law of nature," "natural phenomenon," or "abstract idea."

149 F.3d at ___, 47 U.S.P.Q.2d (BNA) at ___. Claims to a specific machine that lies in the physical realm, however, are not abstract, as the Federal Circuit explained:

> Although many, or arguably even all, of the means elements recited in claim 15 represent circuitry elements that perform mathematical calculations, which is essentially true of all digital electrical circuits, the claimed invention as a whole is directed to a combination of interrelated elements which combine to form a machine for converting discrete waveform data samples into anti-aliased pixel illumination intensity data to be displayed on a display means. n23 This is not a disembodied mathematical concept which may be characterized as an "abstract idea," but rather a specific machine to produce a useful, concrete, and tangible result.

As previously described, claim 10 not only recites using registers and adders but also refers to a specific machine that solves the combinatorial class of problems associated with scheduling; referred to as the Traveling Salesman Problem (TSP). Despite the simple name, this

so-called TSP problem is a class of problems that arises in many different technological context and remains difficult to solve quickly as it is in fact NP complete. Various potential solutions to the TSP problem are suggested to the fitness function recited in claim 10 which in turn converts the potential solution into a number that determines the fitness or relative value of the solution. Accordingly, the present invention provides a practical and effective method of selecting an optimal allocation of resources whether it is on a computer chip or in the scheduling of railways or other technological arts. Clearly, claim 10 is not an abstract concept as it is not only uses registers and adders in the physical realm but is grounded in physical manifestations as it solves the physical problem of scheduling resources in an optimal manner.

The Examiner also rejected claims 10-12 under 35 USC 112, first paragraph because the Applicant had not disclosed a practical application of the invention. Further, the Examiner asserted as a matter of law there is no way Applicant could have disclosed how to practice the undisclosed practical application. Citing the MPEP the Examiner indicated that failure under 35 USC 101 necessarily would lead to a failure under 35 USC 112.

Applicant respectfully submits that the Examiner's assertion under 35 USC 112 is improper in each of the above situations. First, Applicant has clearly indicated that claims 10-18 are directed to patentable subject matter under 35 USC 101 thus the support from the MPEP for

this rejection is not available. Further, the Applicant has disclosed a fitness function to be used in a genetic algorithm architecture for solving combinatorial problems of the sort often referred to as the Traveling Salesman Problem (TSP). For example, FIG. 4 illustrates a digital circuit implementation and corresponding language in the specification on page 8, lines 4-15 and elsewhere in the specification. While the Examiner asserts there has not been a disclosure, one skilled in the art of genetic algorithms would in fact be able to create a fitness function circuit and method for operating such circuit provided the disclosure made in the application as filed. Accordingly, the rejection for claims 10-12 under 35 USC 112, first paragraph should be withdrawn.

Regarding claims 3 and 18, the Examiner rejected these claims under 35 USC 112, first paragraph for allegedly failing enablement. Specifically, the Examiner asserts that page 11, line 1 indicates the addition is done in serial rather than in parallel as recited in claim 3. Regarding page 11, line 1 mentioned by the Examiner, this reference indicates the "particular distance a traveler must make to visit all of the cities in that order" and does not support the Examiner's assertion. Instead, Applicant respectfully submits that one skilled in the art would clearly see FIG. 4 as at least one approach that teaches the parallel addition; at least this reference in the specification satisfies 35 USC 112, first paragraph for claim 3.

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The Examiner also asserts that claim 18 fails enablement under 35 USC 112, first paragraph because the changing out the fitness function or matrix of partial solutions was not addressed. This is also clearly an incorrect assertion with no support. Specifically, the Applicant notes that a matrix of partial solutions is described at least on page 9, lines 4 to 13, page 9, lines 28-34, page 10, lines 1-34 and elsewhere in the application. One skilled in the art would readily understand that the word 'grid' is synonymous with the word 'matrix' or 'table' as used in the specification and therefore understand this teaching. Likewise, the specification clearly teaches one skilled in the art that a matrix of partial solutions would result when connecting a matrix to one part of a register having a complete 'solution' as disclosed in FIG. 4 and on at least page 8, lines 4-16. For at least these reasons, the Application requests that the Examiner also withdraw this rejection under 35 USC 112 first paragraph regarding claim 18.

Additionally, the Examiner rejected claims 4, 11, and 16 under 35 USC 112, second paragraph as being indefinite for using the term 'substantially'. Again, Applicant respectively submits the Examiner has no basis for this assertion. The word 'substantially' is recognized along with words like 'about' as a valid approach to permitting some leeway in the amount of a required constituent in a claim. (*Haynes Int'l, Inc. v Jessop Steel, Co.*8 F.3d 1573, 28 USPQ2d 1652 (Fed. Cir. 1993) See also *Eiselstein v. Frank,* 52 F. 3d 1035, 34 USPQ2d 1467(Fed. Cir.

1995); *Conopco, Inc. v May Dep't Stores Co.*, 46 F.3d 1556, 32 USPQ2d 1225 (Fed. Cir. 1994).) Accordingly, the Applicant would request this rejection is also withdrawn with respect to claims 4, 11, and 16.

Regarding substantive rejections, the Examiner rejected claims 1-18 under 35 USC 102(e) as anticipated by Shackleford (US Pat. 6,185,547). Specifically, the Examiner cites FIG. 7; Col. 4, lines 63-64 of Shackleford as describing a plurality of component parts therefore. Applicant respectfully submits that the Examiner's assertion is incorrect as this portion of Shackleford describes a 'least-fit chromosome register' portion of a genetic algorithm architecture and not the 'fitness function' circuitry as recited in claim 1. For at least this reason, Shackleford does not anticipate claim 1 as amended.

Even if the above reference in Shackleford did describe a fitness function, the Examiner's assertion that Col. 25, lines 32-67 of Shackleford anticipates claim 1 is also unfounded. Instead, Col. 25, lines 32-67 describes a fitness function and hardware circuit specifically for solving a set coverage problem (Col. 25, lines 21-27) and not the "combinatorial genetic algorithm problem" as recited in amended claim 1. The set coverage problem in Shackleford is significantly different from the "combinatorial genetic algorithm problem" recited in claim 1 and thus Shackleford does not teach, or even suggest, this fitness function as asserted.

It is further asserted by the Examiner that Col. 27, lines 25-28 of Shackleford describe the "combinatorial genetic algorithm problem" in claim 1. Applicant respectfully disagrees. Col. 7, lines 25-28 of Shackleford describes a carry-save adder for chromosomes yet this is only a portion of the fitness function being described by Shackleford. Once again, the fitness function in Shackleford describes a fitness function for a set coverage problem and this carry-save adder is just one component for this purpose and it does not teach a fitness function for the "combinatorial genetic algorithm problem" as recited in claim 1 as amended.

Applicant respectively submits that claims 2-9, while allowable on their own accord, depend from claim 1 and therefore are also in condition for allowance for at least the same reasons as claim 1.

Independent claims 10 and 16 are also fitness functions used for "combinatorial genetic algorithm problem" and for at least the same reasons as claim 1 also are in condition for allowance. Dependant claims 11-15 and 17-18 depend from independent claims 10 and 16, and while also allowable on their own, are in conditional for allowance by virtue of their dependence on allowable independent claims 10 and 16.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**Version with markings to show changes made**".

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Applicants have made a diligent effort to place the claims in condition for allowance. However, should there remain unresolved issues that require adverse action, it is respectfully requested that the Examiner telephone Leland Wiesner, Applicants' Attorney at (650) 853-1113 so that such issues may be resolved as expeditiously as possible.

For these reasons, and in view of the above amendments, this application is now considered to be in condition for allowance and such action is earnestly solicited.

Respectfully Submitted,

May 27, 2004
Date

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Version with markings to show changes made

CLAIMS

What is claimed is:

1. (Amended) A fitness function circuit for determining the fitness of a potential solution for a

combinatorial genetic algorithm problem, said fitness circuit comprising:

a solution register containing said potential solution for said genetic algorithm problem therein, said solution register comprising a plurality of component parts thereof;

a plurality of data tables, the number of data tables corresponding to the number of said component parts of said solution register, respective data tables having inputs from two respective ones of said component parts of said solution register, each of said data tables comprising a matrix of partial solutions to said combinatorial genetic algorithm problem, the two respective ones of said component parts determining a particular respective partial solution, each of said matrices having identical entries therein; and

an adder connected to each of said plurality of data tables, said adder adding respective partial solutions from each of said plurality of data tables, thereby determining the fitness of said potential solution for said combinatorial genetic algorithm problem.

2. The fitness function circuit according to claim 1, wherein said data tables include partial solutions specific to the sequential order of the potential solution.

3. The fitness function circuit according to claim 1, wherein said adder adds said partial solutions from the respective data tables in parallel.

4. The fitness function circuit according to claim 3, wherein said partial solutions from the respective data tables are added substantially simultaneously.

5. (Amended) The fitness function circuit according to claim 1, wherein each of said matrices within said data tables comprises an abbreviated matrix of partial solutions to said combinatorial genetic algorithm problem.

6. The fitness function circuit according to claim 5, wherein said abbreviated matrix contains at least (n)(n- 1)/2 entries.

7. The fitness function circuit according to claim 1, wherein at least two of the two respective ones of said component parts correspond to different entries within said matrices.

8. The fitness function circuit according to claim 7, wherein all of the two respective ones of said component parts correspond to different entries within said matrices.

9. (Amended) The fitness function circuit according to claim 8, wherein said combinatorial genetic algorithm problem is the Traveling Salesman Problem.

10. (Amended) A method for determining the fitness of a potential solution for a combinatorial genetic algorithm problem, said method comprising the steps of:

inputting a plurality of potential solution values into a solution register, said solution register comprising a plurality of component parts thereof;

receiving, after said step of inputting, at each of a plurality of data tables two respective ones of said component parts of said solution register, the number of data tables corresponding to the number of said component parts of said solution register, each

of said data tables comprising a matrix of partial solutions to said combinatorial genetic algorithm problem, each of the matrices having identical entries therein;

indexing said matrices of partial solutions to said genetic algorithm within said plurality of data tables, the two respective ones of said component parts determining respective particular partial solutions within the respective matrices; and

adding, by an adder connected to each of the respective data tables, respective outputs from each of said data tables, whereby the sum of said adder determines the fitness of said potential solution for said combinatorial genetic algorithm problem.

11. The method according to claim 10, wherein in said step of receiving, at each of said plurality of data tables, two respective ones of said component parts of said solution register are received substantially simultaneously.

12. The method according to claim 10, wherein in said step of receiving, wherein at least two of the two respective ones of said component parts correspond to different entries within said matrices.

13. The method according to claim 12, wherein all of the two respective ones of said component parts correspond to different entries within said matrices.

14. The method according to claim 13, wherein said combinatorial genetic algorithm problem is the Traveling Salesman Problem.

15. The method according to claim 10, wherein in said step of receiving, at each of said plurality of data tables, two respective ones of said component parts of said solution register correspond to the sequential order of the potential solution values in said solution register.

16. A methodology for determining the fitness of a particular potential solution for a

combinatorial genetic algorithm problem from a pool of potential solutions, said methodology comprising steps of:

(a) inputting a plurality of potential solution values into a solution register, said solution register comprising a plurality of component parts thereof;

(b) receiving, substantially simultaneously, at each of a plurality of data tables two respective ones of said component parts of said solution register, the number of data tables corresponding to the number of said component parts of said solution register, each of said data tables comprising a matrix of partial solutions specific to said genetic algorithm problem, each of the matrices having identical entries therein;

(c) indexing said matrices of partial solutions to said genetic algorithm within said plurality of data tables, the two respective ones of said component parts determining respective particular partial solutions within the respective matrices;

(d) adding, by an adder connected to each of the respective data tables, respective outputs from each of said data tables in parallel, whereby the sum of said adder determines the fitness of said particular potential solution for said genetic algorithm problem;

(e) comparing the fitness of said particular potential solution to a fitness threshold; and

(f) replacing a prior potential solution from said pool of potential solutions with said particular potential solution if said fitness of said particular potential solution exceeds said fitness threshold, and otherwise deleting said particular potential solution.

17. The methodology according to claim 16, said methodology repeating said steps (a) - (f) with another particular potential solution with the same matrix of partial solutions.

18. The methodology according to claim 16, said methodology repeating said steps (a) - (f) with another particular potential solution with another matrix of partial solutions, said another matrix corresponding to partial solutions for another genetic algorithm problem.